

THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY.

[SEVENTH SERIES.]

No. 11. NOVEMBER 1898.

XLI.—*Some new or rare Parasitic Copepods found on Fish in the Indo-Tropic Region.* By P. W. BASSETT-SMITH, Staff-Surgeon R.N., F.R.M.S., F.Z.S.

[Plates X.-XII.]

IN this paper, following two others published in the 'Annals,' I have adduced a few more interesting new forms of these parasitic animals, and also examples of some in which one sex alone has been described. With constant examination of the fresh fish at the markets and at the places where they were landed there was found no dearth of material to work upon; in fact, one is astonished at the great number and variety which are discovered, also how particularly prolific some fish are—the genus *Caranx* being the most noticeable; it was very rare not to find one or more species on a fish: from the inside of the operculum or attached to the head-kidney might be obtained *Caligus tenax*, Hell., *C. carangis*, Kr., *C. robustus*, sp. n.; and on *Caranx djedaba*, *Bomolochus megaceros*, Hell; attached to the gills themselves *Lernanthropus giganteus*, Koll., or a second undescribed species found on *Caranx Rottleri*, the long dark-coloured egg-tubes making them very apparent; once on the surface-skin of a large *Caranx* I found specimens of a fourth species of *Caligus*

(*Caligus longipedis*, sp. n.) ; on the tongue of *Caranx djedaba* was frequently found an ulcerated patch of mucous membrane covered by a small variety ? of *C. tenax* ; on the roof of the mouth of another species (*Caranx ferdau*) were seen the tumours produced by *Caligodes carangis*, sp. n., and once I found the chitinous head and neck of a *Lernæa* deeply buried in the roof of the mouth, the body having rotted away.

In contradistinction to these stand out the fish of the family Sparidæ, which have strong crushing-teeth in the jaws ; I very rarely found any parasites in these fish, the different character of the food, perhaps, causing the peculiarity.

The sharks have many parasites, as described by Krøyer, Steenstrup and Lütken, M.-Edwards, Leach, Van Beneden, Heller, &c. ; but, though there are plenty of these fish in the waters round Aden, it was rarely one saw them before the surface had become too dry &c. A female specimen of *Alebion carchariæ*, however, was found.

The genus *Lernanthropus* appeared frequently, the regular flushing and pallor of the laminate processes representing the third and fourth thoracic feet at every vascular contraction make it evident that they act as branchiæ, as Hesse pointed out in his elaborately illustrated paper in 'Revue des Sciences Naturelles,' tome vii. (June 1878).

Ergasilidæ.

BOMOLOCHUS, Nordm.

Bomolochus megaceros, Hell. (Pl. X. fig. 1.)

As the male of this species has not been recorded, nor has one of any other species of this genus, so far as I have been able to find in published works, been obtained, it seems worthy of placing here on note, especially as though I have examined a large number of the female *Bomolochus*, both living and dead, yet only once was a male discovered. The minute size renders them undoubtedly very difficult to see, and it is only when attached to the female, as occurred in this case, that they are likely to be found. The peculiar elegance of the anterior antennæ, and the large hooked maxilliped with which it firmly attaches itself, were remarkable, being very unlike those of the female, of a much less degraded type. The drawing was made very quickly after capture, but in preparing the specimen for a permanent preparation it was unfortunately spoilt ; therefore there are many points which require further elucidation. The female *Bomolochus megaceros* I have taken from *Stromateus niger*, Bombay, Colombo, and

Beluchistan, and often on *Caranx djedaba*, Aden. The species is well defined and easily recognized.

Length 1 millim. Transparent.

Body distinctly segmented; the cephalothorax elongate, forming a solid carapace, followed by two free short thoracic segments and a large oval genital segment; the caudal portion is biarticulate, the first joint is almost square, the second elongated and tapering, carrying at its extremity two rather large caudal plates, each of these terminating in a very long strong simple bristle, having a minute hair at its base, and also a small one at the base of the caudal plate.

Anterior antennæ long, elegant, five-jointed, the first being short, carrying a long plumose hair on its under border; the second joint is very long, cylindrical, and tapering, bearing along its front border about twelve fine ciliated hairs and one long plumose hair near its termination; the third joint is about half the length of the last, with three plumose hairs near the end, one being extremely long; the fourth of much the same size, with two terminal plumose hairs; the last joint is half as long again as the fourth, terminating in six plumose hairs.

Posterior antennæ spring from close under the first; they are three-jointed, and resemble much the same organs in the female.

Second maxilliped is distinctly three-jointed, being very large and powerful; the basal joint is oval and muscular, the second broad and flattened, the surface being minutely granular, its front edge having a fine tooth about halfway down; the terminal joint is in the form of a long slender claw, with the concave edge minutely toothed; near the base of this and on the opposing joint one sees a fine bristle.

First, second, and third true limbs biramose, each branch three-jointed, the outer branch of the third bearing dentate spurs as in the female, all the others provided with ciliated hairs. Fifth pair uniramous, the terminal joint having its border fringed with fine hairs and terminating in three short thick ones.

Caligidæ.

CALIGUS, Müller.

Caligus longipedis, sp. n. (Pl. X. figs. 2, 3.)

This species was taken from the skin-surface of a *Caranx melamphigus* at Aden; both the male and the female were obtained. In the gills of the same fish were present, especially in the neighbourhood of the gland, numbers of *C. tenax*,

Hell., *C. carangis*, Kr., and attached to the gills themselves many specimens of *Lernanthropus giganteus*, Kr.

This *Caligus* appears at first sight to resemble *C. infestans* of Heller (which I have found also out here attached to the gills of "*Cybium Commersonii*"), but is quite distinct, my species being chiefly distinguished by the structure of the first maxilliped, the narrow flat furcula, the presence of only three joints on the fourth peræopod, the large candal plates, and the surface being spotted with blue instead of red.

Female.—*Carapace* slightly broader than long, with obtusely rounded posterior angles, narrowing considerably in front, where it unites with the anterior cephalic segment; this is the frontal plate, rather deeply emarginate in the centre, but thick antero-posteriorly, the lunulæ being on the outer third, large and very conspicuous, extending the whole width of the plate.

Anterior antennæ: first joint equal in length to the width of the lunule, bearing about fourteen delicate plumose papillæ; second joint longer and slender, bearing at its end a number of fine hairs, with an isolated one on its posterior edge.

Second antennæ of moderate size, the terminal claw being rather slender, the spur from the basal joint being distinct.

Hamulus anterior long, narrow, and curved, springing from a globose base.

Palp large, sharp-pointed, rising from a bifid base and having a slight curve outwards.

First maxilliped has the basal joint of the usual shape, the second of a peculiar form, becoming broader at its termination, with the whole inferior border minutely crenate, almost dentate at the end; this joint terminates in two long curved processes, the outer being the longer and articulate.

Second maxilliped of comparatively very small size, the terminal claw being short and simple.

Furcula very distinct, though of only moderate size; from a dilated base with a narrow neck rise the two branches, which are nearly parallel to one another on the inner border, somewhat rounded on the outer, blunt-ended, and of an extremely flattened appearance, the width of the aperture being less than the length of the arms.

First peræopod of the usual form, the palmar joint carrying three short terminal claws, a slender bristle at the angle, and three moderately long plumose hairs from the under border.

Second peræopod of the usual form.

Third peræopod of very considerable size, the posterior

border of the apron extending over the upper part of the genital segment; the paddle-joints are placed some distance apart, the outer having four short plumose bristles on the inner border and three simple hairs on the outer, the penultimate joint having a long ciliated hair on the inner border and a short one on the outer side. Hamulus posterior rather long and slightly curved.

Posterior thoracic segment very large (about one third as long as broad), giving off the *fourth pereopods*, which are three-jointed and extremely long, extending as far as the caudal plates; the first joint is long and muscular, the second one third as long, giving off on its inner border a single slender curved claw nearly equal to the length of the terminal joint; this last ends in a pectiniform edge and three curved elongate claws placed close together near it, each of these having fine dentations at their bases.

Genital segment heart-shaped, about one third the length of the carapace and rather less broad.

Abdomen indistinctly two-jointed, equalling in length the last segment, the first joint being of a narrow oblong shape; the second is rather longer, broadening at its extremity, where it gives off the two caudal plates; these are very large, with narrow pedicles and square-cut extremities; the inner border runs nearly parallel to the outer and is covered with long cilia; these plates terminate in three long, straight, stout, plumose bristles and a shorter one on the outer border; the stout terminal bristles and caudal plates are pigmented blue; the egg-sacs are long and of a green colour in life.

Length 5 millim.

Male.—This differs from the female in being rather smaller, the carapace is narrower, the genital segment is oblong, the abdomen broader and more distinctly two-jointed, and the caudal plates are oval in shape: of the organs the *posterior antennae* are smaller, terminating in a very short hook; the *hamulus anterior* is longer and more robust; the second maxillipeds have a thicker basal joint, with a double tooth on its inner border, and the terminal claw-joint also has a minute tooth near its extremity.

Length 4.5 millim.

Caligus robustus, sp. n. (Pl. XI. figs. 1, 2.)

A large number of specimens of both sexes were found of this species freely moving about, generally on the inner side of the operculum or on the bony gill-rays of various species of *Caranx* and *Thynnus*, viz. *T. macropterus*, *C. affinis*, and *C. djedaba* at Trincomalee, and *C. Rottleri* at Aden.

This species bears a resemblance to *Caligus irritans*, Hell.*, having the double long-shaped posterior thoracic segment and elongated biarticulate abdomen; it may readily be differentiated by its broader, more arched carapace and strong four-jointed fourth pair of legs, besides many structural details; the male too varies considerably.

Female.—Colour pure white; oculi pink.

Carapace strongly arched upwards, considerably broader than long, narrowing rapidly anteriorly, posterior angles rounded, posterior median lobe broad, sulcus on each side moderately deep. Frontal plate narrow, its anterior edge almost straight; lunulæ at the outer end shallow, small comparatively to those of *C. irritans*.

Anterior antennæ having the first joint about equal in length to width of the lunule; second joint longer and club-shaped.

Second antennæ of the usual form, but the terminal claw is more slender than in general.

Humulus anterior very small, slightly curved; rostrum short.

Palp elongate, curved, with blunted end and an apparent constriction; but no bifurcation is seen near the extremity.

First maxillipeds of the usual form.

Second maxillipeds: these are very strong, the basal joint, both in young and old, having a very strong bifid tooth near the extremity of its inner border, to which the end of the strong terminal claw approximates; at the base of the latter is a fine hair on the concave border.

Furcula of moderate size; a long base with parallel sides and rounded extremity giving off direct two short, flattened, slightly divergent branches with blunted ends, the aperture between them being considerably more narrow than the length of the branch.

First peræopod has three short terminal claws, with three long plumose hairs on the under border of the last joint; but I have been unable to discover the usual simple bristle at the angle.

Second peræopod of the usual form, but the bent short claws on the upper border of the first and second joints of the outer branch are strong, and at the end of the last joint there is a very small spur, with a stronger one deeply fringed with fine hairs on the underside; plumose hairs from beneath as usual.

Third peræopod: paddle-joints rather widely separated, the

* · Reise der Fregatte Novara,' pp. 177-179.

terminal joint of the outer with four ciliate hairs, increasing in length from without inwards; a longer one is seen from the inner side of the penultimate joint; the inner paddle has six plumose hairs on the last joint.

Hamulus with a dilated base and a short, thick, curved claw.

Fourth pereopods, rising from an elongated posterior thoracic segment, are robust in form, four-jointed, the basal joint being of a long oval shape, the three last of nearly equal size, the first two each giving off a strong claw; the last has three placed close together.

Genital segment heart-shaped, having a constriction above, giving the appearance of a double posterior thoracic segment; the whole length equals about two thirds that of the cephalothorax; the rudiments of the fifth pair of limbs are visible on the posterior rounded border.

Abdomen slightly longer than the last segment; it is very constricted at its origin, becoming rapidly broader to near the extremity, where there is another constriction, forming a joint as long as broad.

Caudal plates longer than broad, giving off three short terminal ciliate hairs and two smaller ones on the outer side.

Length 7-10 millim.

Male.—This is smaller, and has the cephalothorax more oval in shape; the genital segment is narrower, terminating posteriorly in two stout spines; two fine hairs are also seen on the outer border; the abdomen is made up of a short broad joint and a second oblong one; the caudal plates are rather large, with the inner borders finely fringed with hairs. The *second antennæ* have the last joint reduced to a short though rather powerful hook, and the hamulus anterior remains of the same size as in the female, which is unusual.

Length 5 millim.

Caligus tenax, Heller. (Pl. XI. fig. 3.)

As the male of this has not yet been described, I here take the opportunity of putting it on record. Heller found specimens of the species on *Caranx carangis*, Brazil; in these eastern seas I have taken very large numbers from the gill-chambers of various species of *Caranx* found at Trincomalee, Colombo, Muscat, and Aden, the males being fairly plentiful; these specimens were seen to have the abdominal segment generally shorter than those described by Heller*, but agree in detail of structure, except that on careful examination the

* 'Reise der Fregatte Novara,' pp. 172-173.

hamulus anterior will be seen to have a short basal spur, which he does not mention; they were generally taken with *C. carangis* of Kröyer *, which is easily distinguished from them by the absence of the small chitinous hooklets on the basal plate of the third peræopods, by the much smaller furcula, by the more rounded genital segment, and the greater size of the fourth pair of legs.

Male.—Taken from *Caranx melamphigus*.

Carapace much broader than long, narrowing quickly anteriorly and slightly at the posterior angles. Frontal plate very wide, deeply concave in front, the lunulæ, which are large, projecting considerably forward.

The *posterior antennæ* have a very short strongly curved terminal claw, which is very different from the long slender one of the female.

Hamulus anterior of moderate size; both basal and terminal spurs are much larger than in the other sex; the thoracic appendages are not altered.

Genital segment about one third as long as the cephalothorax, oblong in form, though narrowing anteriorly; about the juncture of the middle and the last third are three fine hairs placed close together and a single one at the posterior angle.

Abdomen nearly square, about one third the length of the genital segment, bearing the two short caudal plates.

Length 3-4 millim.

CALIGODES, Heller.

Caligodes carangis, sp. n. (Pl. XI. fig. 4.)

This genus was formed by Heller † to include an animal described by Kollar as *Chondrocanthus lanciniatus*, afterwards referred by Kröyer ‡ to Van Beneden's genus *Sciænophilus* as *S. lanciniatus*.

The original specimens were taken from a species of *Belone* and are preserved in the Vienna Museum, being fully described by Kröyer.

On examining large numbers of the larger specimens of fish of the genus *Caranx* in the Aden market, I was struck by the frequency with which one saw on the palate of *C. ferdau* two small hæmorrhagic tumours, placed far forwards near the middle line; on closer inspection there were seen hanging

* 'Bidrag til Kundskab,' 1863, pp. 69-70.

† 'Reise der Fregatte Novara,' p. 180.

‡ 'Bidrag til Kundskab,' 1863, pp. 153-157.

from them slender opaque white bodies, often ten from a single tumour; on dissecting the tumours the head and neck of these peculiar parasites were seen to be deeply buried, the neck often being incased in a sort of red fibrinous tube; on first removing them I thought they were either Chondranchi or one of the nearly allied genera. To the fish they must be a great inconvenience, situated as they invariably were. Only females were found.

The before-mentioned authors describe the elongated portion as a drawn-out posterior thoracic segment, but in these it appears to be a produced neck-like commencement of the true genital segment; my specimens, too, differ in having the fourth pair of thoracic legs well formed, as in *Synestius*, Steenstrup & Lütke*, instead of being rudimentary.

The four-jointed fourth pair of thoracic limbs, the large furcula, and the two laminate prolongations of the abdomen distinguish this species.

Female.—*Carapace* almost circular, very small, equal to about one seventh of the whole animal length. Frontal plate distinct, deeply excavated in the centre between the two lunulæ, which are of moderate size, projecting somewhat in front, but less in diameter than half the frontal plate.

Anterior antennæ have a short basal joint provided with the usual plumose hairs and a much longer second joint with simple hairs at the end.

Posterior antennæ placed well forward near the base of the rostrum; they are three-jointed, the last joint in the form of a moderately strong curved hook.

Hamulus anterior small; it has a broad base, and is in the shape of a simple short claw.

Palp short, simple, and blunt-ended; a second smaller one is seen in front a little to the outside.

Rostrum about twice as long as broad.

First maxilliped of the usual form of *Caligus*.

Second maxilliped powerful; basal joint long and thick, having on its inner surface a curious bifid tooth; the terminal claw is markedly curved.

Furcula very large and prominent; from a narrow neck spring the two branches, which diverge widely and are sharp-pointed, the width of the opening being greater than the length of the arms; seen from the side the furcula has the appearance of a grapnel, being most admirably adapted for fixation of the animal. Oculi of a pink colour, placed over the centre of the rostrum.

* 'Bidrag til Kundskab,' 1861, p. 24.

First peraeopod three-jointed; the first joint has a single hair from the upper border, the second is cylindrical, the third or palmar joint is provided with three short terminal claws, the outer being the longest, and a single bristle at the angle; I was unable to detect any trace of the usual plumose hairs from the under border.

Second peraeopod has each branch provided with three joints; the upper border of each of the outer ones has a single claw; plumose hairs as in *Caligus*.

Third peraeopod has the basal flap broad; on the inner surface near the centre on each side is a patch of small tooth-like processes about twelve in number, also a single row extending from the hamulus upwards; the hamulus is of moderate size and strongly curved; the paddles are small, placed near together, provided with feathered hairs as in *Caligus*, differing from that described by Kröyer. The last thoracic joint is ill-defined, but it appears of a square form, not projecting below the apron of the third pair of limbs.

Fourth peraeopod well formed, four-jointed, the first joint being cylindrical and muscular, four times as long as broad; the other three joints are welded together as in *Caligus*, the terminal giving off three short curved claws placed close together, the outer one being the longest, each of the other joints has a claw of about the same length on its inner border.

Genital segment of a pyriform shape, with a long neck uniting it to the thorax, the whole being three and a half times the length of the cephalothorax, and three times as long as broad; the intestinal canal and ovaries are easily visible in the dilated portion, the ducts of the latter being placed near together; from the under posterior border outside these openings is given off on either side a long laminate process more than one third as long as the last segment, protecting the external ovarian tubes.

Abdomen broad and flat, terminating in two laminate appendages not quite so long as the ventral ones, differing thus markedly from the abdomen of *C. lanciniatus*.

The *caudal plates* are exceedingly small, wedged in between these two processes; they are slightly longer than broad, and give off three fine terminal plumose hairs, with a minute one on the outer border.

Egg-sacs very long, of a brown colour.

Length 11-12 millim.

ALEBION, Kröyer.

Alebion carchariae, Kr. (Pl. XII. fig. 1.)

As only a single example of this animal is on record,

being described by Kröyer * from a male specimen obtained on a large shark in the Atlantic, I here give a short account of the female, which seems, without doubt, to be the same species, taken from a small shark at Aden, which I was fortunate enough to be able to examine immediately after its capture, before the parasites had been washed off, finding two mature females on the surface of the pectoral fin. The description of Kröyer is very full, so that it is unnecessary to enter into too great detail, only to point out the chief differences which appear.

In outward form the dorsal plate covering the last thoracic segment was much less apparent; the genital segment, though of almost equal proportional size to that of the male, had extending between the posterior processes a much shorter biarticulate abdomen, the first joint of which was rounded, slightly broader than long, the second being oval, more than twice as long as the first, giving off two caudal plates of an elongated oblong form, terminating in three large plumose bristles and a small outer one. On minute examination the posterior lobe of the carapace was seen to have on either side four small teeth, and laterally there are three others. The dentations at the posterior border of the genital segment are bicuspid, and those on the elongated portion are larger than the ones represented by Kröyer. The posterior antennæ are larger than in the male; the second maxilliped has a very short robust terminal claw, bearing a hair on the inner surface near the base. The first two peræopods do not vary, but in the third the detail seems to be somewhat different: the outer paddle is large and has three distinct joints, the first having on its inner border a long plumose hair, on the outer border, which is ciliated, there are two short thick bristles, the lower one being the longer; the second joint has a plumose hair on the inner border and one short bristle on the outer, on it is seen one reniform body; the third joint bears two reniform bodies and on the inner border are six plumose hairs: the inner paddle has an elongated stalk-like joint and the final one bears five distinct plumose hairs; the glandular (?) apparatus described by Kröyer is also seen. Fourth peræopods very rudimentary, the proportional size being given in the Plate. On the genital segment three bright red pigment-spots on either side are very apparent.

Length 7 millim.

* 'Bidrag til Kundskab,' 1863, pp. 165-168.

Dichelesthiina.

PSEUDOCYCNUS, Heller.

Pseudocycnus appendiculatus, Hell.

Ten specimens of this rare animal were found attached to the gills of *Thynnus macropterus* at Aden; they were all mature females. These I kept alive for some time. The vascular system is very elaborate, and apparently these animals, like those of the genus *Lernanthropus*, are essentially "blood-suckers," being full of red blood. The specimens originally described by Heller* were taken in the Indian Ocean on a species of "*Coryphæna*," with which these agree in almost every detail, except that in my specimens stump-like rudiments of the fifth pair of limbs carrying a single small hair were present at the extreme end of the genital segment on either side just in front of the flap-like processes which protect the ovarian openings.

Length 10 millim.

LERNANTHROPUS, Nordm.

Lernanthropus nudus, sp. n. (Pl. XII. figs. 2, 3, 4.)

While at Aden I was astonished by the great number of specimens of an animal of this genus which were present attached to the gills of a large grey mullet (*Mugil*, sp.) very common in the market. Scarcely a fish would be examined without finding many specimens; as they attached themselves very firmly, they were not easily washed away. It seems to be a genus widely distributed, and I have taken out here a good many species. This one appears to be very remarkable. Obtaining them fresh and in large numbers, one was able to keep specimens alive for some time, when their brilliant red colouring and movements made them very interesting to watch, as described by Hesse. Both males and females were found separately, and also once "in copulâ," as shown in the figure; the males are much smaller than the females, but did not show the more brilliant colouring, as in Hesse's plates; the free-swimming embryos were taken from a watch-glass about twelve hours after the eggs were discharged. The chief characteristics of this species are the entirely exposed condition of the abdomen and the great length of the processes representing the fourth pair of limbs.

* 'Reise der Fregatte Novara,' pp. 218-219.

Female.—*Head* of large size, longer than broad, largest at the base, which is slightly rounded; it is strongly arched dorsally from side to side, the margin folding inwards on the under surface; in front the border is convex and prominent, showing no median notch, from the underside of which frontal border the six-jointed setiferous anterior antennæ are seen.

Thorax seen from the dorsal surface divided into three segments, each having a median indentation posteriorly; they are broader than the head and are together somewhat longer: the anterior segment is but indifferently marked off; this is the true second thoracic segment bearing the second pair of thoracic limbs, the first being united with the cephalic portion; it is less wide than the following segments and very short: the second free segment is much broader than long, with rounded sides, from under which can be seen projecting the third pair of limbs; the third free thoracic ring is slightly smaller than the last, but of similar shape, being not so long as broad and deeply cut away posteriorly; the sides of these segments are deeply pigmented, and the alimentary canal is easily visible down the centre; the usual posterior tunic or plate common to the whole genus appears to be, however, entirely absent, the abdomen being quite bare, projecting between the two greatly elongated processes representing the fourth pair of limbs; on either side of it from the posterior edge of the lobe of the last segment, is seen a small rounded flap or plate partially covering the base of the fourth pair of limbs; these may be the rudiments of the dorsal tunic.

The *abdomen* is rather longer than the last thoracic segment; it is composed of three distinct portions, the second partially overlapping the third: the first is of a rounded shape, but broader than long; the second is pointed at the extremity, it is constricted in the middle, dividing it into two parts; to the upper and wider are attached the ovarian tubes, to the narrower the two stalked dark spermatophores. The third abdominal joint is oblong in shape, traversed by the intestinal tube; the anal opening is seen at the end between the two caudal plates, which are oval in shape, somewhat divergent, and placed on the under border.

From the ventral side one sees the six-jointed setiferous *anterior antennæ*, and placed far forward the triarticulate *posterior antennæ*; the first two joints of the latter are very broad and muscular, the last in the form of a curved hook: beneath these on the median line is found the mouth, of a pointed conical shape; on each side of this near the base a slender triarticulate and a thicker biarticulate process can be

made out, probably the mandible and palp; on either side a little backwards are placed the two pair of maxillipeds, the first are much the most slender, the second joint having the point somewhat sickle-shaped.

The *second maxilliped* is very strong, the outer extremity of the large muscular joint extending a little beyond the margin of the cephalothorax; the terminal hook-like joint has a small tooth on the concave border about one third from the point. Under the lower margin of the cephalic border are seen the rudimentary first thoracic limbs; they are two-branched and single-jointed, the outer branch being of a square shape, having five short digitations with crenate edges on the border; the inner branch is very small, terminating in a single short bristle. The rudimentary second pair of limbs are placed a little further back and are much smaller than the first, the outer branch carrying four small digitations only; on the inner I could see no bristle. The third pair of limbs are converted into curved foliate processes as usual; they spring from the side and posterior border of the second free thoracic segment; these are very vascular and act as claspers for the animal. The fourth pair of limbs rise on the side of the abdomen from the last thoracic segment; they quickly become split into two processes, very long and narrow, their length being greater than that of the whole of the rest of the animal; they are pale red in colour, pulsatile, and no doubt act as branchiæ, as Hesse suggests; they are in constant motion, curling up and straightening out.

Length without processes 5 millim., with processes 11 millim.

Male.—Much smaller than the female, having the head proportionally larger and more oval in shape. The body is divided into two parts—the first is very short, carrying the second pair of rudimentary thoracic feet: the second portion, which is of a much more regular oval shape, carries on both sides two pair of appendages, the first pair being single-branched, springing from the anterior part, and equal in length to that of the body; the second pair are divaricate, proceeding from the posterior part of the body, and much longer than the anterior pair: between these is seen the genital segment, this tapers considerably to the abdomen, which is oblong in shape, terminating in two leaf-like caudal plates of almost equal length with the abdomen, but rather less than half as broad. The appendages are like those of the female, except that the structure of the terminal joint of the first maxilliped is quite peculiar, being dilated along its concave border and

thickened near the end, where the dentations are coarser; the point is more curved and minutely toothed.

Length without processes 5 millim., with processes 8 millim.

The embryos when first hatched are rounded, with an anterior projecting portion, and are sharp-pointed posteriorly, on each side of which is seen a long bristle; these bear on either side three pair of limbs, the first ending in a single hair, the second with three, the third pair with four. When a little older the body is more distinctly segmented, the second and third limbs become bipartite, each branch of the second has a single joint terminating in two fine hairs; each branch of the third consists of two joints, the end one giving off four long hairs.

The male is seen to attach itself firmly to the abdomen of the female by its powerful posterior antennæ, the body hanging freely between the long laminate processes.

NOTE.

The name "*Helleria*" being already appropriated for more than one genus of crustacean animals, I propose to alter the one so called by me (described in the Ann. & Mag. Nat. Hist. ser. 7, vol. i., January 1898, pp. 10-11, pl. v., and August 1898, vol. ii. pp. 93-94) to "*Cybicola*," to avoid any confusion.

EXPLANATION OF THE PLATES.

PLATE X.

- Fig. 1. Bomolochus megaceros*, ♂, Heller, highly magnified.
 1 *a.* Anterior antenna. 1 *b.* Posterior antenna. 1 *c.* Second maxilliped. 1 *d, e, f.* First, second, and third peræopods. 1 *g.* Fifth peræopod. 1 *h.* Last abdominal joint and caudal plates.
- Fig. 2. Caligus longipedis*, ♀, sp. n., from the back, enlarged.
 2 *a.* Cephalothorax from beneath, much magnified. 2 *b.* First maxilliped. 2 *c.* Third peræopod. 2 *d.* Fourth peræopod. 2 *e.* Caudal plates.
- Fig. 3.* Male of the same from the back, enlarged.
 3 *a.* Posterior antenna. 3 *b.* Hamulus. 3 *c.* Second maxilliped.

PLATE XI.

- Fig. 1. Caligus robustus*, ♀, sp. n., from the back, enlarged.
 1 *a.* Cephalothorax, much enlarged. 1 *b.* Outer branch of the second peræopod. 1 *c, d.* Third and fourth peræopods. 1 *e.* Caudal plate.
- Fig. 2.* Male of the same from the back, enlarged.
 2 *a.* Posterior antenna. 2 *b.* Posterior extremity of genital segment.

Fig. 3. *Caligus tenax*, ♂, Heller, from beneath.

3 a. Hamulus anterior.

Fig. 4. *Caligodes carangis*, ♀, sp. n., from the back, enlarged.

4 b. The same in profile. 4 c. Genital segment and abdomen. 4 d. Cephalothorax from beneath, much enlarged. 4 e. Last joint of the first pereopod. 4 f. Third pereopod. 4 g. Caudal plates. 4 h. Last joint of the posterior antenna. 4 i. Second maxilliped. 4 j. Fourth pereopod. 4 k. Furcula from the side.

PLATE XII.

Fig. 1. *Alebion carchariæ*, ♀, Kr., from the back, enlarged.

1 a. Second maxilliped, much enlarged. 1 b. First and second pereopods. 1 c. Third and fourth pereopods. 1 d. Margin of the genital segment. 1 e. Extremity of posterior process of the genital segment.

Fig. 2. *Lernanthropus nudus*, ♀, sp. n., seen from the back, enlarged.

2 a. The same seen from the side. 2 b. Cephalothorax, much enlarged, from beneath. 2 c. Part of the margin of the first pereopod. 2 d. Abdomen and posterior processes, showing ovarian tubes and spermatophores attached.

Fig. 3. Male of the same, enlarged.

3 a. Male and female "in copulâ." 3 b. Anterior and posterior antennæ. 3 c. Extremity of first maxilliped. 3 d. Abdomen and caudal plates.

Fig. 4. Embryos in two stages of development.

N.B.—The line to the right of a figure shows the natural length of the animal.

XLIII.—*Extraordinary Vitality of Entomostraca in Mud from Jerusalem.* By EDWARD ATKINSON, F.L.S.

JUST forty years ago, when, residing in Jerusalem, I was in the habit of using my scanty leisure in natural-history pursuits, I chanced upon a little discovery which has proved to be of no small interest.

Strolling one hot day in May 1858 by the margin of the old reservoir outside the Jaffa Gate, known as the Birket Mamilla, or Upper Pool of Gihon—then dry—I took a fancy to explore its bed. A few weeks had elapsed since the last of the water had been drawn off through its ancient conduit into the so-called Pool of Hezekiah within the city.

This Pool of Gihon, more than 2500 years old, was probably, when originally constructed, part of the system of pools and aqueducts by which water was brought from the Pools of Solomon at Urtas, beyond Bethlehem, for the supply of the capital; but now little or no water enters it from that source,